

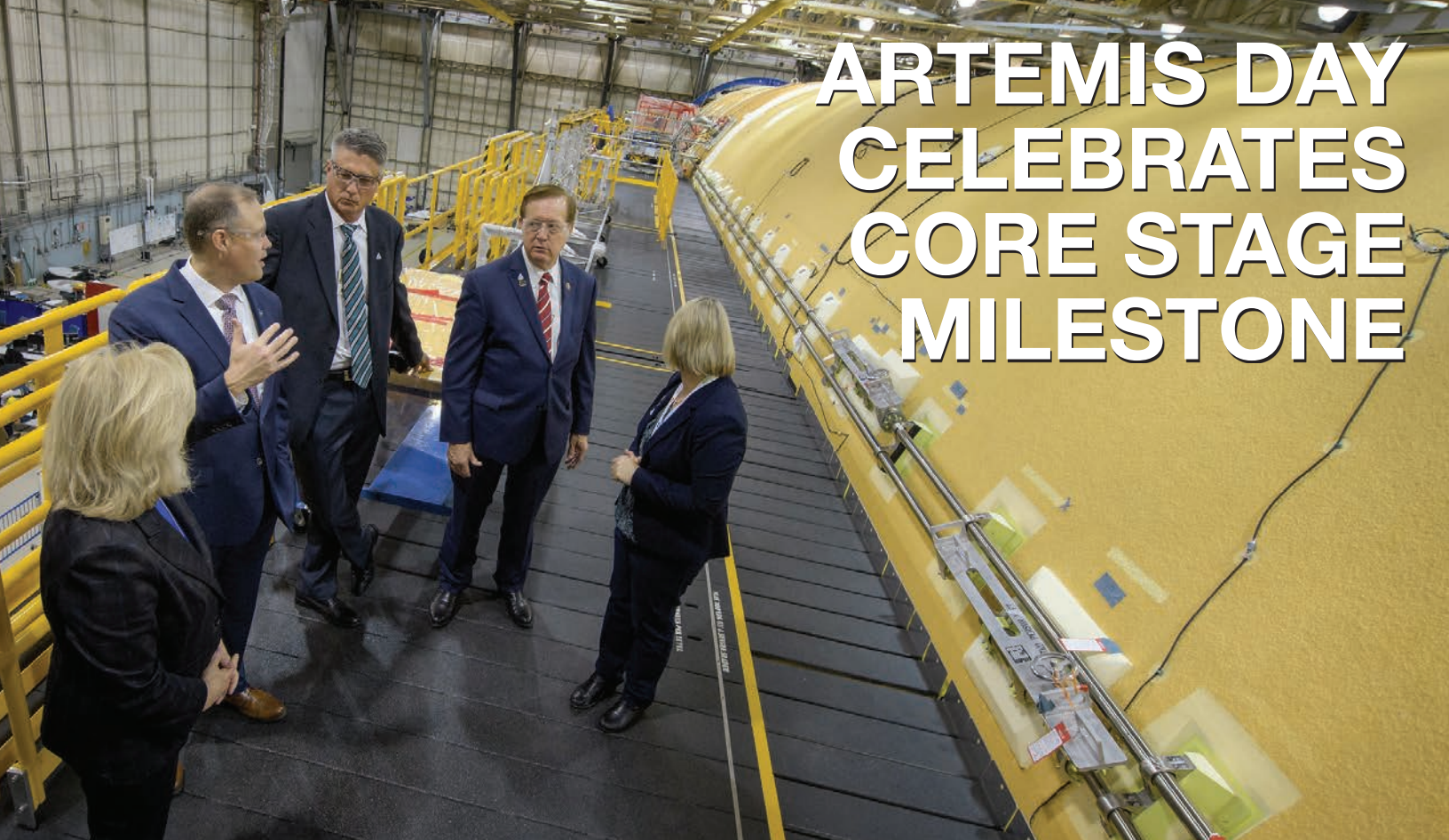
SPACE LAUNCH SYSTEM

DECEMBER 2019



CELEBRATING THE SLS CORE STAGE

ARTEMIS DAY CELEBRATES CORE STAGE MILESTONE



Administrator Jim Bridenstine and other NASA officials check out the massive Artemis I core stage during Artemis Day at Michoud Assembly Facility Dec. 9.



NASA Administrator Jim Bridenstine, agency personnel, media and government officials gathered at Michoud Assembly Facility Dec. 9 to celebrate the completion of the SLS core stage that will send the first Artemis mission to space. The 212-foot-tall stage is undergoing preparations to ship to Stennis Space Center for final testing.

The SLS core stage is the largest stage NASA has built since the Apollo program. Bridenstine said the milestone marked a new chapter in the Artemis story as the agency works to answer the charge to land the first woman and next man on the Moon by 2024.

Read more: go.nasa.gov/2ZF4X5F

2019: BIG PROGRESS FOR NASA'S BIG ROCKET

During 2019, the SLS program made significant progress toward getting NASA's next great rocket ready for the Artemis I mission while looking ahead to future missions. Here's a roundup of some major milestones.

CORE STAGE COMPLETION

The SLS core stage that will send the first Artemis mission into space is complete and being prepped for shipment to Stennis Space Center for its Green Run test series. At 212 feet long, the SLS core stage is the largest stage NASA has produced since the Apollo program. Its five components all came together during the course of the year. Last February, NASA teams at Michoud Assembly Facility completed the "forward join," connecting the forward skirt, liquid oxygen tank and intertank, to form the top part of the core stage. In May, crews joined the liquid hydrogen tank, the largest part of the core stage, to the forward join. In September, the final core stage structure, the engine section, was connected to the bottom of the stage. During the fall, the four RS-25 engines were installed into the engine section. Following various closeout activities, the stage is being prepared in early 2020 to be shipped to Stennis Space Center for a series of tests culminating in an eight-minute test fire.

Learn more about Green Run here: go.nasa.gov/2ZEALaO



The major sections for the SLS core stage for the Artemis I mission were bolted together during 2019.

ENGINE TESTING WRAPS UP

On April 4, teams at NASA's Stennis Space Center wrapped up four-plus years of testing on the RS-25 engines that will help power the SLS rocket's first four missions. Teams from NASA and engines prime contractor Aerojet Rocketdyne conducted 32 tests on 16 former space shuttle main engines for a total of four hours of cumulative hot fire. The tests confirmed that the RS-25 engines can perform at the higher power level needed to launch the super heavy-lift SLS rocket. In addition, the team tested new engine components, including a new engine controller that serves as the "brain" of the engine to help monitor engine operation and facilitate communication between the engine and rocket.

Learn more about the RS-25 engines here: go.nasa.gov/368VGW0



APRIL

The April 4 RS-25 hot fire, conducted on the A-1 test stand at Stennis Space Center, completed a 51-month test series.

PATHFINDERS TRAIN GROUND CREWS FOR LAUNCH PREP

A crucial part of getting the SLS ready for flight is learning how to maneuver the rocket's massive components on the ground. NASA teams conducted lift and transport practice of the core stage and solid rocket booster motor segments by using full-scale models, called pathfinders. Crews installed the core stage pathfinder into the B-2 test stand at Stennis Space Center in August before shipping it via NASA's Pegasus barge to Kennedy Space Center's Vehicle Assembly Building (VAB). Also in the VAB, teams from SLS and Exploration Ground Systems in November practiced booster segment stacking using a center segment and a cylinder that simulated another segment.

Learn more about the pathfinders here: go.nasa.gov/36aRwgt



In the left image, a technician watches as a crane lowers the 225,000-pound SLS core stage pathfinder into High Bay 3 at Kennedy Space Center's Vehicle Assembly Building. At right, a crew watches a stacking exercise of mockup booster motor segments at Kennedy.

HARDWARE UNDERWAY FOR ARTEMIS II AND BEYOND

As final outfitting and integration work is done to get the Artemis I SLS hardware ready for flight, much of the flight hardware for the Artemis II mission – the first crewed mission with SLS and NASA’s Orion spacecraft – is already built. Hardware for future missions is underway as well. All 10 motor segments for the Artemis II mission are cast with propellant and in storage, and the forward and aft assemblies are in production. In addition, four segments of the third flight set of boosters have been cast with propellant. All four RS-25 engines for the Artemis II mission are complete and in storage. Welding on the Artemis II liquid hydrogen and liquid oxygen tanks is complete, and both tanks are in evaluation. For the upper part of the rocket, the launch vehicle stage adapter and interim cryogenic propulsion system are all in production, and the RL10 engines for the second and third missions have completed acceptance testing.

Learn more about the Artemis program here: go.nasa.gov/2Qcu24Z

NOVEMBER



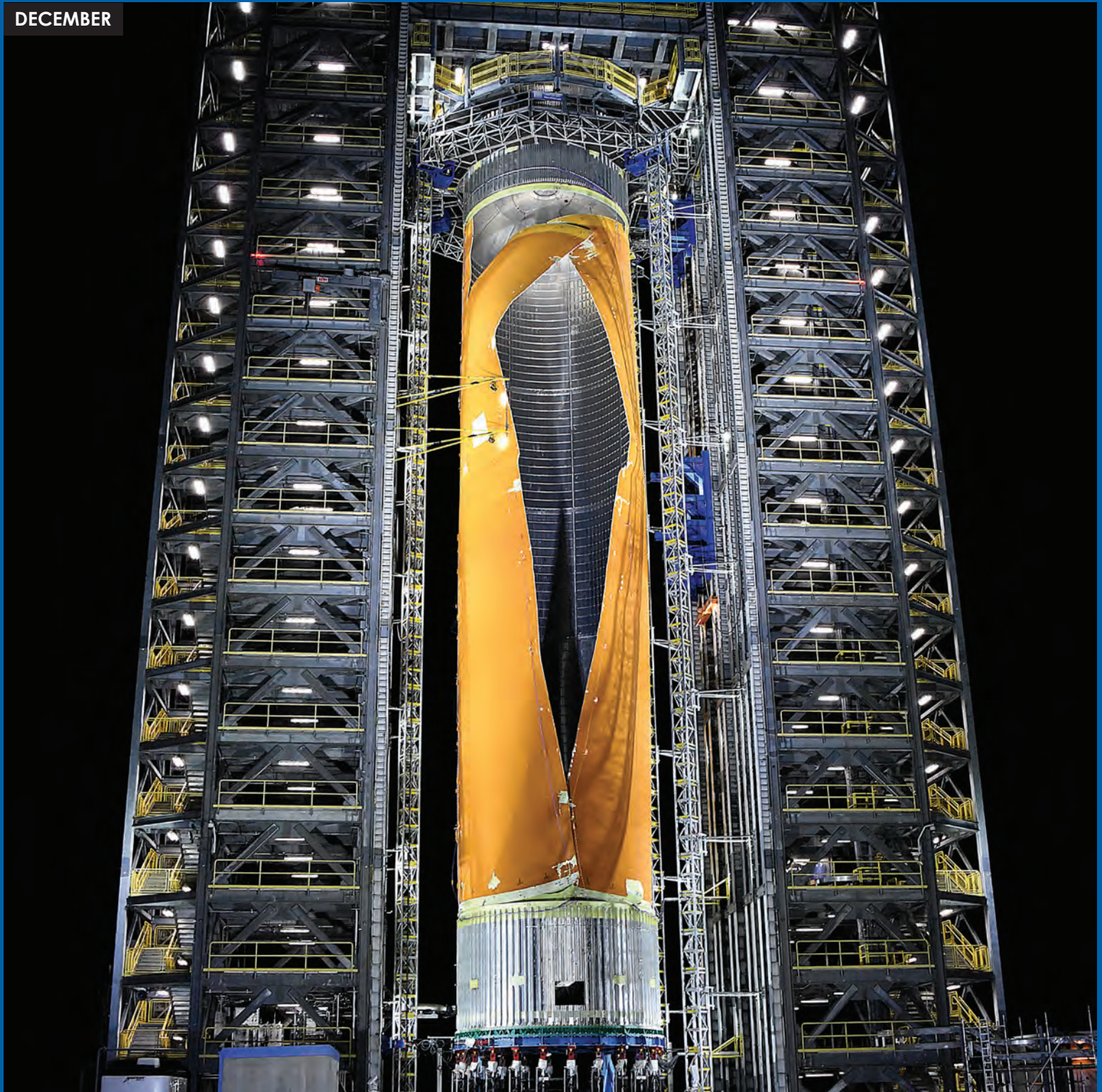
The liquid hydrogen tank for the Artemis II mission, the first crewed mission of NASA’s SLS and Orion spacecraft, completed welding and is in testing to evaluate weld strength and structural soundness.

CORE STAGE STRUCTURAL TESTING ENTERS HOMESTRETCH

In 2019, the SLS team entered the homestretch for structural testing of the rocket's core stage, using test articles that are structurally identical to their flight versions. To ensure successful missions, each of the core stages structures, including the liquid oxygen tank, liquid hydrogen tank, the engine section and the intertank, have undergone testing to verify they can withstand the stresses of liftoff and flight. On Jan. 14, 2019, crews installed the 149-foot-tall liquid hydrogen tank test article into test stand 4693 at Marshall Space Flight Center and began preparing for a series of tests that pushed, pulled and twisted the tank. On Dec. 5, engineers and technicians deliberately pushed the heavily instrumented tank beyond its design limits over a five-hour period, causing the tank to rupture at 260 percent of expected flight loads. NASA also began testing the final structural test article, the liquid oxygen tank, with the second phase of testing scheduled to begin in 2020.

Watch the liquid hydrogen tank test to its breaking point: youtu.be/-W5EXElmqC4

DECEMBER



The test article for the SLS liquid hydrogen tank was deliberately pushed beyond its design limits in testing Dec. 5.

ARTEMIS I BOOSTER AFT EXIT CONES DELIVERED TO KSC

The two solid rocket booster aft exit cones for the SLS rocket's first flight are now at NASA's Kennedy Space Center, where they will be checked out and prepared for the Artemis I mission. Boosters prime contractor Northrop Grumman shipped the exit cones from its facility in Promontory, Utah. The aft exit cones are located at the aft part of each booster and are attached to the nozzles, helping direct booster thrust during launch.

Read the full story: go.nasa.gov/39sl8Yx



The aft exit cones for the Artemis I SLS solid rocket boosters have been delivered to Kennedy Space Center.

WHAT'S NEW IN SLS SOCIAL MEDIA



ROCKET SCIENCE IN 60 SECONDS

Building the SLS rocket's massive core stage is no small task. In this *Rocket Science in 60 Seconds* video, Amanda Gertjeansen, senior production manager for core stage prime contractor Boeing, explains how crews connected the stage's five main structures.

Watch the video here: youtu.be/cjxaJKkmx-o

SLS ON THE ROAD

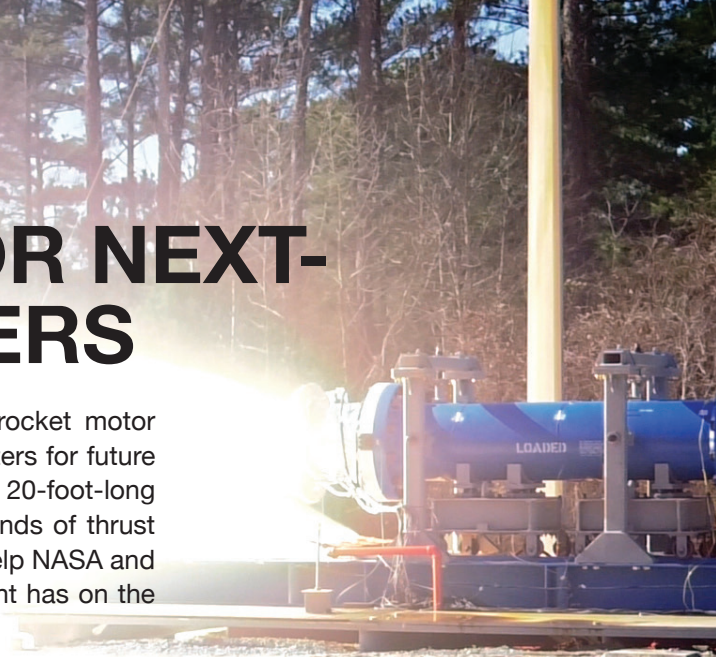


As part of the Artemis Day celebration, social media influencers toured NASA's Stennis Space Center Dec. 10 and learned about the RS-25 engines that will help power the SLS rocket on Artemis missions. During the Stennis tour, the group visited prime contractor Aerojet Rocketdyne's Engine Assembly Facility and the B-2 test stand.

HOT FIRE TESTS MATERIALS FOR NEXT-GENERATION BOOSTERS

Teams at NASA's Marshall Space Flight Center tested a small solid rocket motor Dec. 5 that will help the agency build next-generation solid rocket boosters for future SLS flights. The 20-second hot fire, conducted on a 24-inch-diameter, 20-foot-long subscale test motor at Marshall's East Test area, produced 56,000 pounds of thrust and temperatures of more than 5,000 degrees Fahrenheit. The test will help NASA and prime contractor Northrop Grumman evaluate the effect a new propellant has on the performance of materials used in the motor's insulation and nozzle.

Read the full story: go.nasa.gov/2FgGUka



Teams at Marshall Space Flight Center tested a small solid rocket motor Dec. 5 that will help NASA build next-generation solid rocket boosters for SLS flights.

SPACEFLIGHT PARTNERS: *RdF Corporation*

NUMBER OF EMPLOYEES: 70

LOCATION: *East Aurora, NY*

WHAT THEY DO FOR SLS:

Founded in 1939, RdF Corporation is a leading innovator in the design, development and production of surface, insertion and immersion temperature and heat flux sensors. The company provides surface mount temperature sensors and immersion temperature probe assemblies for the SLS Program.



FOLLOW THE PROGRESS OF NASA'S NEW LAUNCH VEHICLE FOR DEEP SPACE:

Twitter [Twitter.com/NASA_SLS](https://twitter.com/NASA_SLS)

Facebook [Facebook.com/NASASLS](https://facebook.com/NASASLS)

COMING NEXT MONTH:

Artemis I Core Stage arrives at Stennis

What happens during Green Run testing?